

## INSULIN SELF-ADMINISTRATION TECHNIQUE WITH DISPOSABLE SYRINGE AMONG PATIENTS WITH DIABETES MELLITUS FOLLOWED BY THE FAMILY HEALTH STRATEGY

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*This cross-sectional study aimed to describe the most common correct and incorrect self-administration techniques for insulin using disposable syringes by patients cared for by the Family Health Strategy (FHS), relate the findings to sociodemographic variables and also identify the professional responsible for teaching this technique. A total of 169 patients were selected by simple random sampling in 37 FHS units in a city in the state of Minas Gerais, Brazil from August to October 2006. The results identified errors in all the steps recommended by the American Diabetes Association and Brazilian Diabetes Association for the safe administration of insulin, from hand washing to compression on the injection site. The FHS favors the development of interventions focused on the needs of the clientele registered at the unit, stimulating self-care. Results from this study can contribute to the planning of these interventions.*

**DESCRIPTORS:** diabetes mellitus; insulin; self care; nursing; family health

## TÉCNICA DE AUTO APLICACIÓN DE INSULINA CON JERINGAS DESECHABLES ENTRE USUARIOS CON DIABETES MELLITUS ACOMPAÑADOS POR LA ESTRATEGIA SALUD DE LA FAMILIA

*Se trata de un estudio seccional que tuvo como objetivo describir los errores y los aciertos más comunes de la técnica de auto aplicación de insulina, con jeringas desechables, por los usuarios, acompañados por la Estrategia Salud de la Familia (ESF), así como relacionar lo encontrado a las variables sociodemográficas e identificar al profesional responsable por las orientaciones. Participaron 169 usuarios, seleccionados por medio de un muestreo aleatorio simple, en 37 unidades de la ESF, de un municipio del Estado de Minas Gerais, entre agosto y octubre de 2006. Los resultados identificaron errores en todos los pasos recomendados por la Asociación Americana de Diabetes y la Sociedad Brasileña de Diabetes para la aplicación segura de la insulina, desde el lavado de las manos hasta la compresión del local de aplicación. La ESF favorece el desarrollo de intervenciones con foco en las necesidades de la clientela adscrita, estimulándola para el auto cuidado, y los resultados del presente estudio podrán contribuir para la planificación de esas intervenciones.*

**DESCRIPTORES:** diabetes mellitus; insulina; autocuidado; enfermería; salud de la familia

## TÉCNICA DE AUTOAPLICAÇÃO DE INSULINA COM SERINGAS DESCARTÁVEIS ENTRE OS USUÁRIOS COM DIABETES MELLITUS, ACOMPANHADOS PELA ESTRATÉGIA SAÚDE DA FAMÍLIA

*Estudo seccional que objetivou descrever os erros e os acertos mais comuns da técnica de autoaplicação de insulina, com seringas descartáveis, pelos usuários, acompanhados pela Estratégia Saúde da Família (ESF), assim como relacionar esses achados às variáveis sociodemográficas e identificar o profissional responsável pelas orientações. Participaram 169 usuários selecionados por meio de amostragem aleatória simples, em 37 unidades da ESF, de um município do Estado de Minas Gerais, entre agosto e outubro de 2006. Os resultados identificaram erros em todos os passos recomendados pela Associação Americana de Diabetes e Sociedade Brasileira de Diabetes para a aplicação segura da insulina, desde a lavagem das mãos até a compressão do local de aplicação. A ESF favorece o desenvolvimento de intervenções centradas nas necessidades da clientela adscrita, estimulando-a para o autocuidado, e os resultados do presente estudo poderão contribuir para o planejamento dessas intervenções.*

**DESCRIPTORES:** diabetes mellitus; insulina; autocuidado; enfermagem; saúde da família

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## INTRODUCTION

The need to use exogenous insulin to maintain good metabolic control has been increasingly acknowledged as a therapeutic option for diabetes mellitus type 2 (DM2)<sup>(1)</sup> in addition to being a classical indication for diabetes mellitus type 1 (DM1). Multiple daily doses of insulin need to be injected into the subcutaneous tissue to achieve glycemic control, which has been shown to be an essential condition to prevent acute and chronic complications of this disease<sup>(2)</sup>.

The most used instrument among the several available in the Brazilian market to inject insulin into the subcutaneous tissue is the disposable syringe due to its low cost, easy access, health professionals' familiarity<sup>(3)</sup> with its use and also because it is freely distributed by government institutions according to the Federal law n° 11.347 from September 27, 2006<sup>(4)</sup>.

For glycemic control done through insulin therapy with disposable syringes to be effective, several things need to be learned<sup>(3,5-6)</sup>. Among them is the administration technique, considered one of the factors influencing the effectiveness of insulin:<sup>(5,7)</sup> inadequate and unsafe practices in the administration of insulin can interfere in the metabolic control and consequently lead to the development of DM chronic complications<sup>(8-9)</sup>.

Due to the increased number of people with DM using insulin in recent years, more emphasis should be given to the standardization and improvement of insulin administration technique, focusing on properly teaching this technique so that people become aware of their responsibility and make less mistakes during insulin administration<sup>(3)</sup>.

Even though some studies have focused on the many variables related to the insulin administration<sup>(3,5-6)</sup>, there is a need to introduce the process of insulin self-administration with disposable syringes in the current context of health policies, that is, in the Family Health Strategy (FHS) context.

Because the FHS aims to reorganize the delivery of primary health care and ensure that individuals with DM receive integral, equitable care with case-resolution ability, interventions in health should be developed with an adequate knowledge of people's context so to favor the establishment of goals and practices that effectively meet the needs of populations.

Based on the above, this study aimed to identify the most common incorrect and correct procedures in the insulin self-administration technique with disposable syringes, relate the findings to sociodemographic variables and identify the professional responsible for providing instructions on how to self-administer insulin.

## METHOD

This qualitative, cross-sectional study was carried out in 37 FHS units between August and October 2006 in the metropolitan area of a city that is considered an important economic center and point of reference in the areas of health and education in the state of Minas Gerais, Brazil

The population base comprised 781 FHS service users with DM taking insulin. The following inclusion criteria were considered: 18 years of age or older, registered at the FHS, taking insulin for more than one year, being responsible for the administration of insulin and using disposable syringes.

According to the established inclusion criteria, 231 patients were not included in the study: 100 did not self-administer insulin, 31 were younger than 18 years of age, 82 were administering insulin for less than one year, 12 were registered for less than one year at the FHS and four used the insulin pen injector. Thus, the study population was composed of 550 patients.

A list with the names of the 550 individuals distributed in the 37 FHS units was developed, aiming to draw their names through a simple random sampling using the Statistical Package for the Social Science (SPSS) version 15.0. In order to calculate the sample size, a prevalence of 50% of self-administration, confidence interval of 95% and sample loss of 15% were considered.

Thus, the sample was composed of 186 individuals. Seventeen individuals were lost during the study due to the following reasons: 11 were not found at home after three visits, one was hospitalized, three died and two refused to participate in the study, totaling a final sample of 169 individuals.

After defining the variables, an instrument to collect data was developed with closed and structured questions to be applied through direct interviews. This instrument presented data concerning sociodemographic and clinical conditions (gender, age,

schooling, duration of diabetes and of insulin treatment), description of steps for preparing and injecting insulin according to the American Diabetes Association (ADA)<sup>(7)</sup> and the Diabetes Brazilian Society (SBD)<sup>(8)</sup> and a list of professionals responsible for providing orientation for the insulin self-administration technique.

Depending on the variables' nature, they were presented in tables of absolute frequencies (n) and relative frequencies (%) or through central tendencies (average and median) and variability measures (minimum, maximum and standard deviation - sd). Associations between the dependent variables were elaborated: percentage of correct steps performed in the insulin preparation and administration technique with independent variables: gender, age range (adults and elderly), schooling, duration of the disease and of the insulin treatment, were analyzed through the following tests: the Mann-Whitney test and Kruskal, Wallis and Spearman's correlation. Type I error of 5% was adopted in the statistical analysis for all tests.

The FHS coordination in the city where the study was carried out and the Committee on Ethics and Research with Human Beings at the Federal University of Triângulo Mineiro approved the study (Protocol No. 527). Participants signed a free and informed consent agreement, which permitted data collection and the use of data therein.

## RESULTS

### Sociodemographic and clinical variables

According to sociodemographic and clinical variables, 120 patients (71%) are women, 93 (55%) are 60 years old or older and 146 (86.4%) have less than eight years of education, the average time of schooling was six years (sd 3). It is worth highlighting that 38 (22.5%) had no formal education.

In terms of time of the disease diagnosis, the average was 13 years (sd 8), median of 12, maximum of 40 and minimum of one year. Regarding the duration of the insulin treatment, the average was seven years (sd 5), median of six, maximum of 30 and minimum of one year.

The data analysis of the insulin self-administration technique based on the ADA<sup>(8)</sup> and SBD<sup>(9)</sup> recommendations was divided in three stages:

hand washing, insulin preparation and administration; those steps that can interfere with the safety and efficacy of the insulin administration were highlighted. Data are presented in Table 1.

The self-administration technique of a mixed dose of insulin in the same syringe is not analyzed in this study because none of the patients followed such a practice, even those who exclusively used the syringe attached to a needle (53.8%).

Table 1 – Numerical and percentage distribution of people who self-administer insulin and are cared for in the FHS units (N=169), according to the insulin administration technique, 2007

Insulin self-administration technique	Always		Sometimes		Never	
	N	%	N	%	N	%
Hand washing	150	88.8	9	5.3	10	5.9
Observe the insulin characteristics	154	91.1	3	1.8	12	7.1
Mix insulin without shaking it	101	59.8	1	0.6	67	39.6
Wipe the rubber top of the insulin bottle with alcohol at 70%	-	-	-	-	169	100
Inject air into the insulin bottle	44	26	10	6	115	68
Remove bubbles from the syringe	153	90.5	3	1.8	13	7.7
Draw up the quantity of insulin necessary to complete the prescribed dose	154	91.1	3	1.8	12	7.1
Recap the needle up to the moment of administration	14	8.3	-	-	155	91.7
Cleans the skin with alcohol at 70% and allows it to dry	-	-	-	-	169	100
Pinch a fold of skin	130	77	10	5.9	29	17.1
Inject the needle at a 90-degree angle	80	47.3	17	10.1	72	42.6
Aspirate fluid back into syringe to check for blood return	50	29.6	6	3.6	113	66.8
Wait five seconds to withdraw the needle	23	13.6	3	1.8	143	84.6
Compress the skin without massaging it	83	49.1	15	8.9	71	42

It is worth mentioning that 59.8 and 78.7% of the patients wipe the rubber top of the insulin bottle and clean the skin, respectively, with alcohol of a concentration less than 70% (they use ordinary alcohol sold in supermarkets). All those who clean the skin prefer to wait for the alcohol to dry.

In regard to which professionals teach the technique, we found that 86 (41.5%) of patients reported the physician, 46 (22.2%) the nurse, 13 (6.3%) the nursing auxiliary or technician, six (2.9%) reported the health communitarian agent, four the pharmacist (1.9%), two (1%) the biophysician, one (0.5%) the nurse at the reference hospital, one (0.5%) the dentist at the FHS unit and one (0.5%) reported

the nutritionist. In addition to information they received from professionals, four (1.9%) reported they also have obtained information in magazines. We highlight that 43 (20.8%) patients reported the need for formal orientation on this technique.

The following results were obtained after analysis of the steps of the insulin self-administration technique recommended by the ADA<sup>(8)</sup> and SDB<sup>(9)</sup>: 35% was the minimum percentage of steps correctly performed, maximum of 94%, average of 61%, standard deviation of 10% and median of 65%. The *angle of needle during administration* and *aspiration after puncture* was considered correct based on body mass index (BMI), as the needle provided by the FHS is 13mm long.

We observed that 63 (37.3%) patients presented BMI $\leq$ 25 and used a 13mm needle. Of these, 36 (57.1%) injected the needle at a 90-degree angle and 41 (65.1%) did not draw back the syringe plunger to check for blood return.

When these scores are related to gender, age and education, no statistically significant difference was found between men and women (Mann-Whitney test,  $p=0.532$ ), between patients older than 60 years of age (Mann-Whitney test,  $p=0.234$ ) nor between patients with no formal education, less than eight years of education and nine or more years of education (Kruskal-Wallis test,  $p=0.356$ ).

No statistically significant differences were found in the average of time from the DM diagnosis (Spearman's correlation,  $p=0.18$ ) or duration of the treatment with insulin (Spearman's correlation,  $p=0.46$ ) in relation to the average of steps correctly performed in the self-administration technique.

## DISCUSSION

The therapeutic success of insulin does not depend only on its type and dose prescribed but also on how it is administered. Thus, the recommendations provided by the ADA<sup>(8)</sup> and SDB<sup>(9)</sup> on the preparation and administration of insulin involving consecutive stages can contribute, when properly followed, to safe practice and achieving treatment goals and preventing or delaying acute and chronic complications due to poor metabolic control. For that, health professionals also need to make a detailed evaluation of visual, motor or neurological deficits of patients before providing them the sequential steps of this technique<sup>(11)</sup>.

In the analysis of the first stage of the self-administration technique, the procedure *hand washing*, we found that 88.8% of the participants used water and soap or liquid detergent before preparing and administering the insulin. Hand washing before administering insulin is a necessary step to avoid contamination of material and consequently prevent infection in the site of application<sup>(8-9)</sup>.

The second and third steps of the insulin self-administration technique involve procedures with consecutive steps, which means that expected results will be achieved only if all steps are properly followed<sup>(8)</sup>.

In the analysis of the second stage of this technique, insulin preparation, we found that the majority (91.1%) followed its first step, which is to observe the insulin characteristics before its administration. Insulin's physical characteristics depend on its classification, for instance, NPH and regular insulin uniformly present cloudy and clear aspects, respectively<sup>(8-9)</sup>.

Hence, in case the insulin appears to have lumps or flakes or if it becomes opaque, the bottle has to be discarded<sup>(8-9)</sup>. The factors that alter its characteristics are related to excessively shaking the bottle, exposing it to temperatures under 2°C or above 30°C and when opened insulin reaches its expiration date<sup>(8-9)</sup>. The NPH insulin in use can be stored either in the refrigerator or at room temperature for one month<sup>(8-9)</sup>.

When the insulin is stored in the refrigerator, it has to stay far from the freezer or cooling plates. The door is not an adequate storage option because it presents a higher variation of temperature and moves the bottle each time it is opened. Thus, the ideal place to store the insulin bottle is the vegetables drawer or the first shelf closest to it<sup>(8-9)</sup>.

Not observing these recommendations may alter the potency of insulin. We note that while the majority (91.1%) of participants observed whether the insulin presented physical alterations before administering it, many did not adopt actions to prevent them. One example is the fact that only 59.8% of the participants mix the insulin gently rolling the bottle between hands and are careful to not vigorously shake it<sup>(8-9)</sup>.

The procedure related to cleansing the bottle rubber top with alcohol at 70% concentration is recommended to diminish the risk of contaminating the needle when injecting it into the

bottle, minimizing potential cutaneous infections on the site, especially among patients who reuse disposable syringes<sup>(8-9)</sup>. However, participants did not report the use of alcohol at 70% and all those (59.8%) who perform antisepsis of the rubber lid use the common alcohol found in supermarkets, which is cheap and easy to access.

The procedure of drawing air into the syringe in volume equal to that of the insulin to be aspirated and turning the bottle up side down aim to avoid bubbles in the syringe<sup>(8-9)</sup>. Although many of the participants did not follow these recommendations, 90.5% reported they eliminate bubbles in the syringe. The little bubbles do not cause any harm when injected but their presence reduces the quantity of insulin to be administered<sup>(8-9)</sup>.

Recapping the needle after preparing the insulin up to the moment of its administration is recommended to avoid the needle touching any surface other than the skin, which can cause contamination and lead to potential cutaneous complications when injected into the skin, though only 8.3% of the participants reported this procedure.

In the third step of the insulin self-administration technique, the insulin administration technique in relation to the skin antisepsis, all (78.7%) those who reported such procedures, opt to use common alcohol found in supermarkets instead of the alcohol at 70%, the concentration recommended by the ADA<sup>(8)</sup> e SBD<sup>(9)</sup>.

The step of allowing the alcohol to dry so it does not penetrate the puncture minimizes pain at the moment of applying the insulin. There are other small precautions that minimize pain during the self-administration procedure: not applying the insulin while it is cold, eliminating bubbles in the syringe, relaxing muscles during insulin injection, rapidly inserting the needle into the skin, not moving the needle during the application and not reusing needles<sup>(8-9)</sup>.

In relation to the routine procedure of pinching a fold of skin before injecting the insulin, 77% of the participants reported it should be done and the pinch released before taking the needle out. This step aims to ensure the needle goes through the subcutaneous tissue instead of the muscle<sup>(8-9,12)</sup>.

The literature recommends inserting the needle at a 90-degree angle, that is, perpendicular to the skin<sup>(8-9)</sup>. However, an angle smaller than 90 degrees might be necessary in case of children and people

with BMI smaller or equal to 25 when needles of 12.7mm or longer are used to avoid injecting the insulin into the muscle<sup>(12)</sup>. With that in mind we observed that 36 (57.1%) patients made mistakes that can cause insulin to be injected into the muscle, which causes episodes of hypoglycemia<sup>(12)</sup>.

The same happens with the procedure of pulling the plunger back so as to verify blood return before the insulin application. This is not a necessary procedure as long as all devices adequate to the BMI<sup>(8-9,12)</sup> are used. However, as the FHS units do not have needles of different lengths available, the verification of blood return is necessary at least in patients with BMI  $\leq 25$  and who report inserting the needle at a 90-degree angle, perpendicular to the skin<sup>(12)</sup>. We observed that 41 (65.1%) patients are at risk of injecting the insulin into the muscle.

The procedure of waiting five seconds before removing the needle is performed by 13.6% of the patients. This procedure avoids leakage of insulin ensuring that the administered dose is equivalent to the prescribed dose<sup>(8-9)</sup>.

The recommendation after removing the needle is to compress the locale where insulin was injected from five to eight seconds without massaging it. Massaging the site alters the medication's time of action. Thus, physicians and nurses should pay attention to this orientation because 42% of the study participants massage the site instead of compressing it<sup>(8-9)</sup>.

Even though there was no association between gender, age and education with the average of correct steps performed in the self-administration technique, it is acknowledged that health interventions are hampered when educative actions do not consider patients' individual differences<sup>(13)</sup>.

The results analysis shows the need for professionals at the FHS units to take early action regarding the determinants that hinder the procedure being performed as recommended, to plan the acquisition of material according to the population's characteristics (i.e. needle length and type of syringe)<sup>(3)</sup> and also to share responsibility and strengthen bonds with patients and their family members so as to encourage their participation in their self-care.

The findings reinforce the need to provide ongoing training to professionals who work at FHS units since 20.8% of the participants reported lack of knowledge regarding the steps to be followed in

the self-administration technique and also a large number of mistakes were found in the performance of these steps.

Even though nurses' technical and scientific knowledge of the administration of medication<sup>(14)</sup> put them in a strategic position to orient the process of insulin administration at the patients' home, the participation of nurses was less expressive (22.2%) when compared to that of physicians (41.5%).

It is worth highlighting the participation of other professionals in orienting people in self-administration technique such as dentists, pharmacists, nutritionists and biophysicians. The inclusion of other professionals at the FHS units was established as a resource to link different sources of knowledge due to the complexity health problems impose, however, each professional should be aware of the limits and potential of their roles and be responsible for providing guidance appropriate to each field of knowledge<sup>(15)</sup>.

Therefore, the role of professionals is to identify strategies to develop safe self-care abilities of people with DM and their family members based on scientific evidence since the daily administration of exogenous insulin is essential to maintain normal glycemic levels.

The guidelines governing the FHS permit closer proximity and interaction between professionals and patients, enabling the establishment of trust, communication and bonds, so that both find solutions that better meet the needs of patients and the community.

## CONCLUSIONS

All patients committed errors in some step of the insulin self-administration technique and the main professional responsible for teaching the insulin preparation and administration technique was the physician (41.5%).

The average score of steps correctly performed during the insulin preparation and administration technique was 61% (sd 10%) and no statistically significant association was found between this average and the sociodemographic and clinical variables.

## FINAL CONSIDERATIONS

Because disposable syringes are freely distributed by the government, we highlight the importance of health professionals to be familiar with its use methods as well as with the complications that might arise if it is inappropriately used.

The patients' adoption of inadequate and unsafe practices represents a weakness in the FHS delivery of integral care to DM patients, which consequently hinders the delivery of good quality care with case-resolution ability. On the other hand, we believe that understanding these gaps can enable the FHS to propose actions focused on individuals' real needs, thus, providing safety and encouraging self-care and at the same time strengthening the FHS capability for case resolution proposal.

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